
DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]In this invention, the speckle pattern of a laser beam is changed into the image data of particles, and this image data is analyzed by a PIV ("Particle Image Velocimetry") program.
Therefore, it is related with the measuring method which measures the amount of elastic displacement of a sample.

[0002]

[Description of the Prior Art]As a distortion (extended or shrinkage) measuring method of a noncontact type using a laser beam, JP,61-27681,B and JP,7-4928,A have art of an indication. This art irradiates with a laser beam from two places which separated a predetermined distance to the sample to one place or the distortion direction which should be measured, inputs that catoptric light into an image sensor, and measures a speckle pattern. And the cross correlation function of the speckle pattern information before and behind the modification in an irradiation position is computed, and the movement magnitude of a speckle pattern is calculated, or the distortion amount of the two above-mentioned places is computed from the difference of the movement magnitude of two places.

[0003]

[Problem(s) to be Solved by the Invention]However, the above-mentioned conventional technology carries out photoelectric conversion of the speckle pattern with a linear image sensor, obtains the speckle pattern information digitized by the strength of the electrical signal, and computes movement magnitude by analyzing this directly. For this reason, an analysis program for exclusive use needs to be developed for the analysis of a speckle pattern, and it cannot but become expensive. Mastering operation of an analysis program also takes time.

[0004]The purpose of this invention is to provide the measuring method which is comparatively cheap and measures the amount of elastic displacement of a sample simply and certainly using a general-purpose image-analysis program, though it is a noncontact type using the speckle pattern of the laser beam.

[0005]

[Means for Achieving the Goal]This invention is provided with the next composition in order to attain the above-mentioned purpose. Namely, an invention of claim 1 irradiates a point with a laser beam first by the second marked line that kept a necessary distance from a point by this first marked line from from by the first marked line of a specimen surface, A speckle pattern of the scattered light which the above-mentioned laser beam at the time of the amount measurement of elastic displacement reflected is digital-data-ized with an image sensor (charge coupled device), for example, CCD. Subsequently, after changing the above-mentioned digital data into image data of particles, it analyzes by a PIV analysis program. A PIV analysis program is one of the fluid-analysis methods, creates a vector map of a flow from a particle image in a fluid, and conducts various analyses, such as a flow direction and speed. In this invention, analysis is regarded as that as which particles expressed an interference fringe, computes movement magnitude of a point individually by the first and the second marked line from a picture before and behind displacement, and obtains the amount of elastic displacement of a sample between points from both movement magnitude by the first and the second marked line. Each marked-line equivalent point is individually irradiated with a laser beam, or from one laser light source, as it straddles between both marked-lines equivalent points, it irradiates with sheet light. In the case of sheet light, it is chosen suitably that an image sensor uses a thing with a lens etc.

[0006]When the amount of elastic displacement of a sample exceeds a laser light source in a fixed position, and a range which can be measured with an image sensor, an invention of claim 2 corresponds. An invention of claim 2 irradiates a point with a laser beam by the second marked line that kept a necessary distance from a point by this first marked line from from by the first marked line of a specimen surface, A speckle pattern of the scattered light which the above-mentioned laser beam at the time of the amount measurement of elastic displacement reflected is digital-data-ized with an image sensor, After changing this digital data into image data of particles, at a point which computes movement magnitude of a point individually by the first and the second marked line, it is common in claim 1 by analyzing by a PIV analysis program. A different point is one of points of carrying out move change of a laser beam irradiation position and the position of an image sensor so that a point may be followed by a point or the second marked line by the first marked line, corresponding to movement magnitude of a marked-line equivalent point. The amount of elastic displacement of a sample is computed from this variation and the above-mentioned movement magnitude.

[0007]

[The best gestalt of operation] Hereafter, based on an example illustrating this invention, it explains in full detail. It is a conceptual lineblock diagram of a device with which drawing 1 applied a block diagram of this invention method, and drawing 2 applied this. The numerals 1 in a figure are the samples used as a measuring object, and the amount of elastic displacement between the points B is measured by the second marked line with the point A by the first marked line. 2 and 3 are the first semiconductor laser and the second semiconductor laser which irradiate the point B with a laser beam almost respectively vertically by the point A or the second marked line by the first marked line, and both laser differs in wavelength of light in this example.

[0008]4 and 5 are the first and the second CCD which were installed in a position which catoptric light of each semiconductor laser inputs. Catoptric light (drawing 2 destructive

line arrow) accomplishes a speckle pattern which is a random interference pattern with detailed unevenness of the marked-line equivalent point surface. This speckle pattern is digital-data-ized when caught by each CCD 4 and 5. This digital data is inputted into the computer 6 via an input port. Detailed particles are suitably changed into image data gathered and dispersed in irregular, and inputted digital data is recorded. Conversion to image data may be before a computer input.

[0009]General PIV analysis plog RAMUTO is installed in the computer 6. For example, it is inputted via first CCD4, and by the first changed marked line, a vector map is created by PIV analysis program and, as for image data before and behind movement of the point A, movement magnitude is calculated based on this. Movement magnitude is calculated by catoptric light from the point B being similarly recorded as image data, and being analyzed by the second marked line. The amount of displacement of the sample 1 between the points B is computed by the second marked line with the point A by the first marked line by measuring and calculating these both movement magnitude. Marketed another general calculation program is used in a comparison operation. A program which draws a distortion curve is incorporated if necessary.

[0010]Unitization of the first and the second semiconductor laser 2 and 3, and CCD 4 and 5 is carried out, respectively, and they have the tracking apparatus 7 and 8 individually. The tracking apparatus 7 and 8 comprise drive mechanism which carries out parallel translation of the unit of the semiconductor lasers 2 and 3 and CCD 4 and 5 to a specimen surface, for example based on a control signal, a stepping motor as the driving source, etc. A control signal is emitted from a tracking apparatus drive controlling program included in a computer, when movement magnitude of the point B exceeds a spot diameter of the fixed semiconductor lasers 2 and 3 by the point A or the second marked line by the first marked line, for example, or when an acceptance surface product of CCD is exceeded. With this control signal, only prescribed distance carries out move change of the unit of the semiconductor lasers 2 and 3 and CCD 4 and 5 in the predetermined direction (the move direction of a marked-line equivalent point) (migration length of a marked-line equivalent point). Thereby, positioning correction of the laser beam is made so that the points A and B may always be irradiated by the first or the second marked line. On the other hand, positioning correction of CCD 4 and 5 is made at a position which receives catoptric light of a laser beam certainly.

[0011]Displacement by the whole points A and B can be known by the first and the second marked line with the semiconductor lasers 2 and 3 and tailing variation of CCD 4 and 5 accompanying this tracking operation, and movement magnitude of the marked-line equivalent points A and B. A distortion amount equivalent to a JIS standard which calculates a distortion amount for two points of a sample is obtained by this.

[0012]

[Effect of the Invention]According to this invention, the speckle pattern of a laser beam is digital-data-ized with an image sensor, Since the amount of elastic displacement of the sample was obtained in changing this digital data into image data, and analyzing the picture before and behind elastic displacement by a PIV program, Unlike the conventional example directly analyzed by the strength of a one-dimensional electrical signal, by a two-dimensional general-purpose image-analysis program, comparatively cheaply easily, moreover, it is accurate and the amount of elastic displacement can be measured. Since move change of the irradiation position of a laser beam and the position

of an image sensor is carried out corresponding to the amount of elastic displacement of a sample according to this invention concerning claim 2, also when the amount of elastic displacement is big, the amount of displacement of the sample between the two marked lines can be measured certainly, and measurement which suits a JIS standard can be performed.

[Translation done.]

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
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CLAIMS

[Claim(s)]
[Claim 1]A point is irradiated with a laser beam by the second marked line that kept a necessary distance from a point by this first marked line from from by the first marked line of a specimen surface, A speckle pattern of the scattered light which the above-mentioned laser beam at the time of the amount measurement of elastic displacement reflected is digital-data-ized with an image sensor, After changing this digital data into image data of particles, by analyzing by a PIV analysis program, The amount measuring method of elastic displacement of a noncontact type using a laser beam characterized by what movement magnitude of a point is individually computed by the first and the second marked line, and the amount of elastic displacement of a sample between points is obtained for from both movement magnitude by the first and the second marked line.
[Claim 2]A point is irradiated with a laser beam by the second marked line that kept a necessary distance from a point by this first marked line from from by the first marked line of a specimen surface, A speckle pattern of the scattered light which the above-mentioned laser beam at the time of the amount measurement of elastic displacement reflected is digital-data-ized with an image sensor, After changing this digital data into image data of particles, by analyzing by a PIV analysis program, So that movement magnitude of a point may be individually computed by the first and the second marked line and a point may be followed by a point or the second marked line by the first marked line corresponding to the above-mentioned movement magnitude, The amount measuring method of elastic displacement of a noncontact type using a laser beam characterized by

what a laser beam irradiation position and a position of the above-mentioned image sensor are changed, and the amount of elastic displacement of a sample is obtained for from this variation and the above-mentioned movement magnitude.

[Translation done.]